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Reply to Final Office Action of September 23, 2005
Docket No. UMJ-116-D (UM 2172p2)

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REMARKS

Entry of the foregoing amendments to the application is requested on the grounds that the claims, as amended, patentably distinguish over the cited art of record or, alternatively, place the application in better condition for appeal. The claims more particularly point out and distinctly claim the subject matter which Applicants regard as the invention. No new issues have been added which would require further consideration and/or search, nor has any new matter been added. The claims as amended are believed to avoid the rejections applied in the Final Office Action for reasons set forth more fully below.

The Final Office Action of September 23, 2005 has been received and carefully reviewed. It is submitted that, by this communication, all bases of rejection are traversed and overcome. Upon entry of this communication, Claims 1-20 remain in the application. New claims 25-38 have been added in order to set forth additional specific embodiments of Applicants' invention. New claims 25-38 had been presented for examination in one of the instant application's parent applications, namely U.S. S.N. 10/393,962. Support for these new claims may be found throughout the specification as filed and in the claims. Reconsideration of the claims is respectfully requested.

Claims 1-20 stand rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The Examiner states that there is no support in the specification for the pretreatment step. The Examiner's attention is directed to the specification at least at page 12, lines 6-14, which fully supports the pretreatment step. As such, the Applicants assert that the rejection based upon 35 U.S.C. 112, first paragraph is erroneously based, and withdrawal of the same is requested.

Claims 1-20 stand rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Specifically, in claim 1, the Examiner states that term "dehydrated" is indefinite since it is unclear how it is dehydrated, such as by drying, centrifuge, or heating.

Applicants respectfully disagree with the Examiner's assertion that the term "dehydrated" is indefinite. The Examiner's attention is drawn to claim 1, which states in part:

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...the process comprises pretreating an adsorbent to form the dehydrated adsorbent, the pretreatment process comprising the steps of: calcining the adsorbent between about 350°C and about 450°C in an inert, dry atmosphere for an amount of time ranging between about zero hours and about 20 hours; and then cooling the adsorbent. (*emphasis added*)

Applicants respectfully submit that claim 1 recites that the dehydrated adsorbent is formed via calcining. As such, the Applicants assert that the rejection based upon 35 U.S.C. 112, second paragraph is erroneously based, and withdrawal of the same is requested.

Claims 1-4, 7, 8, 15, 16, 17, 19, and 20 stand rejected under 35 U.S.C. 103(a) as being obvious over Michlmayr (U.S. Patent No. 4,188,285) in view of Milton (U.S. Patent No. 2,882,244).

The Examiner states that Michlmayr discloses a process of removal of thiophenes from gasoline by contacting the feed with an adsorbent which is silver exchanged faujasite zeolite, namely silver-Y zeolite. The Examiner states that Michlmayr does not disclose if the sorbent is dehydrated or not. The Examiner concludes, however, that it would have been obvious to one skilled in the art to have modified the Michlmayr process by dehydrating the sorbent (if wet) since it is "non-sense" to use a wet sorbent for the process.

The Examiner further admits that Michlmayr does not disclose how to activate and regenerate the spent adsorbent. The Examiner states that Milton teaches activating and regenerating a molecular sieve adsorbent used for removing thiophene by raising the temperature. As such, the Examiner asserts that it would have been obvious to modify the Michlmayr adsorbent to maintain its life.

The Examiner also admits that Michlmayr is silent as to the mechanism of how thiophene is bound to the adsorbent. The Examiner asserts, however, that it is expected that the silver-Y zeolite adsorbent of Michlmayr is inherently bound to thiophene by π -complexation. The Examiner goes on to state that it is expected that the Michlmayr adsorbent can inherently adsorb more than 1 mmol/gram of thiophene since the adsorbent of the claimed process and the one of Michlmayr are similar.

Still further, the Examiner admits that Michlmayr does not disclose that the silver exchanged Y zeolite is Ag(I)Y. The Examiner asserts that it would be obvious to have modified the Michlmayr process by using Ag(I)Y since it is expected that using any silver exchanged zeolite would yield similar results. The Examiner also admits that Michlmayr

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does not disclose that the gasoline is unleaded. However, the Examiner asserts that it would have been obvious to have modified the Michlmayr process by using unleaded gasoline.

Applicants agree that Michlmayr does not explicitly state that the sorbent is not dehydrated. However, one skilled in the art is cognizant of the fact that, if one does not dehydrate zeolites at temperatures at or above about 350°C, they remain partially or fully hydrated.

Zeolites have a strong affinity for water, and some molecules are tenaciously held. The presence of adventitious water will affect the cation coordination in the zeolites, as determined through powder diffraction analysis, and the adsorption of guest molecules, as measured by adsorption isotherms. Furthermore, dehydration conditions strongly influence the formation of silver clusters. To separate these effects, the atmosphere, temperature, and length of time of dehydration were rigorously controlled.

(see Hutson et al., "Silver Ion-Exchanged Zeolites Y, X, and Low-Silica X: Observations of Thermally Induced Cation/Cluster Migration and the Resulting Effects on the Equilibrium Adsorption of Nitrogen" *Chem. Mater.*, **12**, 3020-31, 3022 (2000); previously cited in Applicants' Information Disclosure Statement submitted on June 10, 2004.

As Michlmayr does not teach heating the sorbent or otherwise dehydrating prior to use, he implicitly teaches that the sorbent is **fully hydrated**, and thus is incapable of π -complexation.

Applicants respectfully disagree with the Examiner's assertion that the Michlmayr adsorbent is inherently bound to thiophene by π -complexation. To facilitate π -complexation, a dehydrated adsorbent, as recited in Applicants' claim 1, is used. If water molecules remain in the adsorbent, π -complexation will not occur at sites that are binding water molecules. Applicants respectfully disagree that it would be "non-sense" to use a wet, or a dry but not dehydrated, sorbent for adsorption of sulfur, because a wet or a dry, but not dehydrated, sorbent (such as that taught in Michlmayr) will adsorb, just not via π -complexation. Since Michlmayr does not teach or suggest that the adsorbent is dehydrated, it is submitted that it is not inherent that the binding of thiophene to the Michlmayr adsorbent would occur via π -complexation.

Further, Applicants respectfully submit that neither Michlmayr nor Milton teaches a dehydrated adsorbent that preferentially adsorbs thiophene and/or thiophene compounds via π -complexation. Milton '244 itself teaches away from such π -complexation (and certainly

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shows that such is NOT inherent from its disclosure), by specifically stating that the selectivity was through kinetics--see Col. 10, lines 16-18:

Activated zeolite X on the other hand, exhibits a selectivity based on the size and shape of the adsorbate molecule (emphasis added).

Thus, Applicants respectfully submit that Milton '244 does not teach, suggest or even inherently show the possibility of having an enhanced capacity for thiophene/thiophene compounds through pi-complexation or any other specific solute-surface interactions. In sharp contrast, Applicants' invention as defined in claim 1 recites that the dehydrated adsorbent includes at least one of a metal and metal ion adapted to form π -complexation bonds with thiophene/thiophene compounds, with the preferential adsorption occurring by π -complexation.

As such, it is submitted that it would not be obvious that the activation and regeneration processes for an adsorbent that does not π -complex (described in Milton) would be useful for an adsorbent (such as that recited in Applicants' claim 1) that is capable of π -complexation.

Still further, Applicants respectfully disagree with the Examiner's assertion that the Michlmayer adsorbent inherently adsorbs more than 1/mmol/gram of thiophene. Michlmayer teaches that the sulfur capacities range from 0.07 wt.% to 0.15 wt.% for Ag-Y, with a maximum of 0.2 wt.% (0.0238 mmol/g) (see Examples 1 and 2 of Michlmayer, Column 2, lines 35-62). It is submitted that the lower sulfur capacities described in Michlmayer result, at least in part, from water molecules remaining in the zeolite. As previously stated, Michlmayer does not teach or suggest that the adsorbent is dehydrated. As such, it is not inherent that a non-dehydrated adsorbent would adsorb as much thiophene/thiophene compounds (over 40 times more than that taught in Michlmayer) as the dehydrated adsorbent recited in Applicants' claim 1.

For the all reasons stated above, it is submitted that Applicants' invention as defined in claims 1-4, 7, 8, 15-17, 19, and 20 is not anticipated, taught or rendered obvious by Michlmayer and Milton, either alone or in combination, and patentably defines over the art of record.

Claims 9-11 and 14 stand rejected under 35 U.S.C. 103(a) as obvious over Michlmayer in view of Milton, and further in view of Tsybulevskiy et al. (2002/0009404). The Examiner

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admits that Michlmayr does not disclose a carrier for the adsorbent. The Examiner states, however, that Tsybulevskiy discloses an adsorbent also containing a binder, such as silica, and Milton discloses how to activate and regenerate a molecular sieve. The Examiner concludes that it would have been obvious to one skilled in the art to modify the process of Michlmayr by including a binder in the adsorbent to arrive at Applicants' invention, since it is expected that this would increase the strength of the adsorbent. The Examiner further concludes that once the silica was selected, metals are expected to cover the binder.

Applicants respectfully submit that the combination of Michlmayr, Tsybulevskiy and Milton does not render Applicants' invention as defined in any of claims 9-11 and 14. Reiterating the above arguments, neither Michlmayr nor Milton teaches adsorbing thiophene or thiophene compounds via π -complexation.

Further, the process taught in Tsybulevskiy actually teaches away from π -complexation by specifically stating that the selectivity was through physical adsorption--see Page. 3, paragraph [0036]:

These higher molecular weight sulfur compounds are then adsorbed by these synthetic faujasites. The **physical adsorption** of these sulfur compounds on zeolites is increased, due to their higher molecular weight. Because the adsorption of the sulfur compounds on the synthetic faujasites of the present invention is a two-stage process, i.e., first catalytic conversion of sulfur contaminated compounds, followed by **physical adsorption** of the catalytically converted products, these synthetic faujasites which are the subject of the present invention are termed "adsorbent-catalyst." (*emphasis added*).

Applicants respectfully submit that the Tsybulevskiy does not teach, suggest or even inherently show the possibility of adsorbing through π -complexation. As such, the Examiner's suggested combination does not render Applicants' invention as defined in claim 1 (from which claims 9-11 and 14 depend), which recites preferential adsorption via π -complexation.

For all the reasons stated above, it is submitted that Applicants' invention as defined in claims 9-11 and 14 is not anticipated, taught or rendered obvious by Michlmayr, Milton, and Tsybulevskiy, either alone or in combination, and patentably defines over the art of record.

Claim 18 stands rejected under 35 U.S.C 103(a) as being obvious over Michlmayr in view of Milton, in view of Tsybulevskiy et al., and further in view of Satokawa et al.

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(2001/0014304). The Examiner admits that Michlmayr does not disclose that the silver is silver nitrate. However, the Examiner states that Satokawa discloses an adsorbent containing silver nitrate that is used for thiophene adsorption. The Examiner concludes that it would have been obvious to combine the teachings to render Applicants' invention as defined in claim 18.

As previously stated, the combination of Michlmayr, Milton, and Tsybulevskiy does not render an adsorbent capable of π -complexation, as recited in Applicants' claim 1. Satokawa teaches an adsorbent for the removal of sulfur from natural gas. Applicants respectfully submit that one skilled in the art is cognizant of the fact that natural gas and gasoline are different, and that gas is generally easier to work with than liquids. As such, it is not obvious that an adsorbent suitable for removal of sulfur from a natural gas would be suitable for removal of sulfur from liquid gasoline.

Assuming *arguendo* that one skilled in the art would combine the suggested references, the combination would not render Applicants' invention as defined in claim 18, as none of the cited references teach the preferential adsorption of thiophene/thiophene compounds by π -complexation.

For all the reasons stated above, it is submitted that Applicants' invention as defined in claim 18 is not anticipated, taught or rendered obvious by Michlmayr, Milton, Tsybulevskiy, and Satokawa, either alone or in combination, and patentably defines over the art of record.

Examiner's Response to Applicants' Arguments

1. The Examiner states that Applicants' Declaration that Michlmayr's sorbent is not dehydrated is not persuasive since Applicants do not indicate where in the Michlmayr patent it is disclosed that it is a non-dehydrated sorbent. The Examiner asserts that this is a conclusion without proof from Applicants. The Examiner then states that "Michlmayr's sorbent must be a dry one since it is non-sense to use a wet sorbent for the process."

A. *Applicants' answer to Examiner's Response 1.* Applicants submitted a Declaration by Ralph T. Yang, Ph.D., an expert in the relevant art, stating that Michlmayr's adsorbent is not dehydrated. A Declaration pursuant to 37 C.F.R. 1.132 is considered evidence. To still further substantiate Dr. Yang's Declaration, as shown in the arguments

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above, if Michlmayr did not state that his sorbents were dehydrated, by the nature of zeolites, the skilled artisan recognizes that the sorbents are hydrated.

It is submitted that the Examiner's statement that "Michlmayr's sorbent must be a dry one since it is non-sense to use a wet sorbent for the process" is an unsubstantiated, conclusory statement. Applicants request that the Examiner provide a technical reference and/or a patent reference including scientific proof of such "non-sense;" otherwise it is submitted that the Examiner's unsupported statement has NOT rebutted Dr. Yang's Declaration and the further evidence gleaned from the Hutson et al. paper cited above.

2. The Examiner states that the argument that Tsybulevskiy teaches away from π -complexation is not persuasive since Applicants do not claim how the carrier is bonded with the sulfur compound, but state that the metal has this kind of bonding.

B. Applicants' answer to Examiner's Response 2. Applicants respectfully submit that the Examiner's assertion is not accurate. Claim 9 recites that the carrier has the monolayer of a d-block transition metal compound dispersed at least partially thereon, and that the metal compound releasably retains the thiophene/thiophene compounds. As such, Applicants do recite that the carrier bonds the thiophene/thiophene compounds via π -complexation with the metal/metal ion. In sharp contrast, the adsorbant of Tsybulevskiy teaches adsorption via physical adsorption.

3. The Examiner states that the argument that Satokawa teaches an adsorbent for removing sulfur from a gas not a liquid is not persuasive since it is expected that in any environment – liquid or gas – the Satokawa adsorbent can remove thiophene.

C. Applicants' answer to Examiner's Response 3. Applicants again respectfully submit that the Examiner's statement is unsupported by scientific fact or evidence. It is well known that chemistry is an "unpredictable" art. As such, Applicants request that the Examiner provide a technical reference and/or a patent reference including scientific proof that the environment of adsorption (liquid or gas) has no impact on adsorption of thiophene; otherwise it is submitted that the Examiner's unsupported statement has NOT rebutted Applicants' arguments.

In summary, claims 1-20 remain in the application. New claims 25-38 have been added. It is submitted that through this communication, Applicants' invention as set forth in these claims is now in condition for suitable for allowance. Should the Examiner believe

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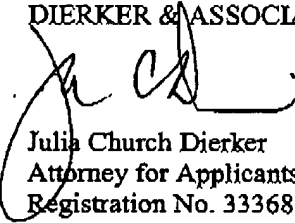
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otherwise, it is submitted that the claims as amended qualify for entry as placing the application in better form for appeal.

Further and favorable consideration is requested. If the Examiner believes it would expedite prosecution of the above-identified application, he is cordially invited to contact Applicants' Attorney at the below-listed telephone number.

Respectfully submitted,

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